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Combat Crew

strategic air command

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JULY 1979

General R. H. Ellis
Commander in Chief, SAC

Let's Talk . . . SAFETY

This edition of Combat Crew marks the start of its 30th year of publication. When the first issue came out in 1950, the Command had a mishap rate of 43 major (class A) mishaps per 100,000 flying hours. Although that rate was not uncommon in those days, it was as unacceptable then as it would be today.

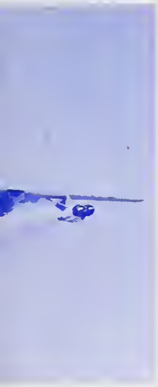
That same year SAC's mishap rate was above the Air Force average — but never again. Through the years, our safety record has steadily improved and last year we had just .27 mishaps per 100,000 flying hours — the lowest in the Command's history. Because of this superb showing and the excellence of our ground and nuclear safety programs, SAC was awarded the highest Air Force safety award, the Secretary of the Air Force Safety Award, and the Order of the Daedalians' prestigious Major General Benjamin D. Foulois Memorial Award for flight safety. Everyone in the Command can be proud of this impressive and enviable record and I applaud each of you.

That's the good news.

The bad news is that even 1978, our banner year, was clouded by two very serious, avoidable mishaps. Valuable equipment was lost, resources were consumed for costly repairs, and of greatest importance, highly trained people were killed. And 1979 has already been plagued by a number of operational mishaps that could have been avoided. Specifically:

— A B-52 sustained major damage when an engine separated from the aircraft. The aircraft had a history of engine torching and both the ground crew and aircrew had indications of

FLARE



torching with over temp conditions during engine starts prior to takeoff.

— A serious incident occurred when a munitions loading crew used unauthorized procedures to open the bomb bay doors on a B-52 prior to a download operation. This was SAC's first weapons incident as a result of personnel error since 1973.

— A number of mishaps have occurred involving aircraft departing the hard surface runway during takeoff or landing.

There are more examples, but these are enough to show that we are not doing as well as we should or as well as I know we can. Safety — although we teach, preach, and evaluate a number of different ideas and techniques — boils down to a matter of self-discipline: knowing your job, knowing your limits, devoting your total attention to the task, and above all, doing the job correctly — no shortcuts . . . just as the checklist reads.

This type of self-discipline is an attitude that must start at the top and go all the way through the chain of command to each crew member and every technician. That means it starts with me — **and it does.** It means that safety — on the ground, in the air and within the silo — is a top priority throughout SAC and of personal interest to me. And I expect each of you to share this same attitude toward safety.

You have proven in the past that you can do it . . . and I am confident the men and women of SAC will continue to lead the Air Force in demonstrating that self-discipline and a totally professional attitude are the keys to a safe operation.★★★★

Lt. Col. Daniel Gornell
HQ SAC, DOWA

White lightning comes in two forms: both kinds can bite you. Compared to moonshine, the other critter is wild, sassy, and unpredictable. We're talking about the flash that streaks about the sky zapping anything that gets in its way.

Lightning strikes to airborne aircraft are still a menace. Composite materials and "all-weather" apparatus have increased the likelihood that encountering one of these flashers can really get your attention. But before we harangue you about the no-no's of flying too close to thunderstorms, let's briefly look at Mother Nature and see why lightning is a necessary evil.

BACKGROUND

The earth and its atmosphere can be thought of as a giant spherical electric condensor (or capacitor); a charged earth surrounded by an electrosphere, an ionized region located some 50 km above the earth. The intervening air or atmosphere represents the dielectric (or insulator). Although the atmosphere is considered a relatively good electric insulator, it does conduct electricity by transporting electrostatic charges in the form of ions. Hence, a very small electric current is generated by the movement of these charges through the atmosphere in response to the electric field associated with the earth-ionosphere electric potential difference.

Atmospheric ions can be obtained by adding or deleting an electron from the neutral molecules of atmospheric gases. Ion production in the atmosphere is brought about mainly by the bombardment of the atmosphere by cosmic and ultraviolet radiation from space. Both of these actions, i.e., the electric charge transfer between the earth and the electrosphere as well as the never-ceasing production of atmospheric ions, are continuous natural processes which produce what is known as the "fair weather" electric field.

By far, the greatest portion of the earth's surface is under a fair-weather electric field at any given time. It has been estimated that the fair-weather current would almost completely discharge the

LIGHTNING STRIKES AGAIN!

earth-electrosphere condensor in about five minutes. However, the fair-weather electric potential gradient remains essentially constant. This implies that there is a compensating electric charge being transported in the opposite direction. It is generally believed that this compensating electric charge is maintained by an oppositely directed current flow through the many thunderstorms always in progress around the world — variously estimated between 1400 to 3000 at any one time.

LIGHTNING

Atmospheric processes, such as updrafts, winds, precipitation, et cetera, sometimes separate or move charged particles around in an organized manner so that relatively small portions of the atmosphere acquire a huge excess of charge. These volumes of excess charge are called space charges (or charge centers). Lightning results when the localized field near the boundary of one of the centers becomes large enough to permit an ionized channel to develop and propagate between two charges of opposite sign. As the conducting channel taps the other charge center, a large, rapid surge of current flows between the centers. This is the lightning flash.

Various theories have been advanced to explain how the actual space charge separation mechanism ultimately leads to lightning. For our discussion these theories are unimportant. What is important is that there is no known technology to prevent lightning strikes to aircraft. Thus it becomes important to avoid flying into areas conducive to lightning strikes; i.e., stay away from thunderstorms.

Lightning may strike an airborne aircraft due to the proximity of the aircraft to the developing lightning path. The aircraft geometry may provide a local field distortion on the order of twice the major dimensions of the aircraft. To begin, the lightning process is typically originated by a "stepped leader" which develops from the cloud to the ground, or toward another charge center within the same cloud or another cloud. The stepped leader is not to be confused with the actual lightning stroke. It is the precursor which ionizes a path through the intervening air between charge centers. This ionized path allows the return stroke, the lightning stroke, to

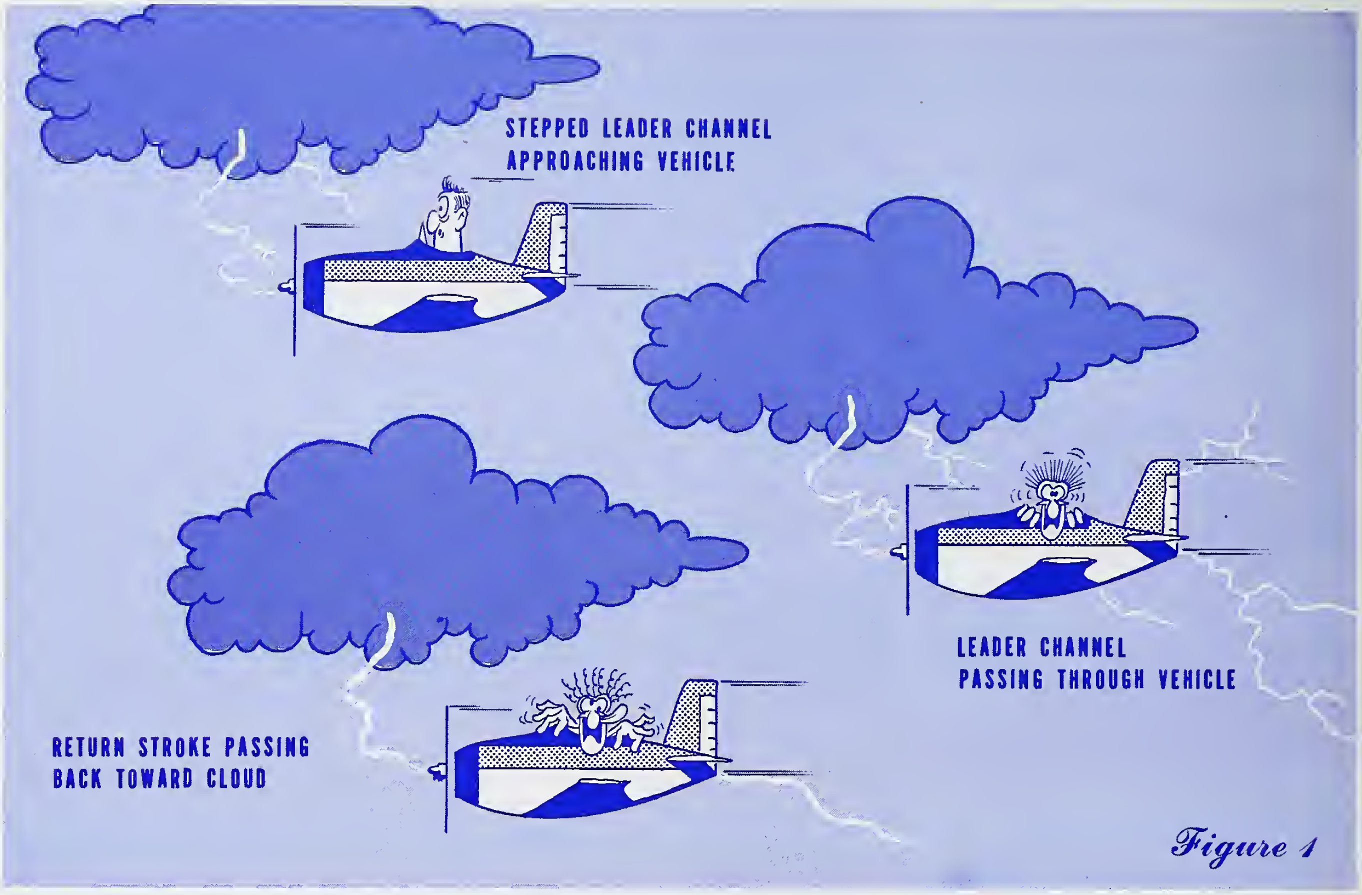

STEPPED LEADER CHANNEL APPROACHING VEHICLE
LEADER CHANNEL PASSING THROUGH VEHICLE
RETURN STROKE PASSING BACK TOWARD CLOUD

Figure 1

equalize the charge distribution between the charge centers.

As a stepped leader approaches the extremity of an aircraft, intense highly distorted electrical field components are produced on the aircraft's surface. These electrical fields give rise to other electrical streamers which propagate away from the aircraft until one of them contacts an approaching stepped leader (Fig. 1). Propagation of the stepped leader will continue from the aircraft extremities until one of the branches of the stepped leader reaches the ground or another charge center. When this occurs, the electrical circuit is completed and the return stroke, a very large current (as much as 200,000 amperes), is exchanged within microseconds. Thus, the aircraft, actually making up a section of the total lightning path, conducts the full current. Fortunately, the lightning current usually restricts itself to passage along the outer aircraft skin, with little damage to personnel, fuel tanks, and internal equipment. However, the huge current and the transient electromagnetic field associated with rapid time variations in the current can affect instrument performance, and if part of the path has high resistance, e.g., a radome, explosions can result. Moreover, the inflight loss of at least two military aircraft has been attributed to lightning ignition of fuel.

The potential danger of lightning appears likely to increase in the future as we obtain:

(1) increased usage of microprocessors (digital systems) which can easily be "scrambled" or damaged by lightning; and

(2) aircraft made up of more and more poorly conducting composite materials, such as boron and graphite. A poor conducting material, such as a radome, can cause a problem when it becomes part of the lightning circuit. Its large resistance will produce a large potential difference across it causing the material to heat up rapidly. The rapid heating can literally explode the material due to the expansion of gases trapped in tiny pores, produced by vaporized moisture, or contained in the material itself.

Under what meteorological conditions do lightning strikes to aircraft occur? In almost all cases, the aircraft was flying in, beneath, near, or between thunderstorms. There are some interesting and useful statistics regarding aircraft lightning strikes. About half of the lightning strikes occurred between March and July. This would be expected since this is the height of the thunderstorm season in the northern hemisphere. Approximately 64% of the strikes occurred in the space bounded by plus/minus 5°C, and 70% of the strikes occurred when aircraft were flying between 2000-12,000 feet. The preponderance of strikes between these altitudes coincides with the region most likely to be between the various cloud-to-ground charge centers. Moreover, the majority of lightning discharges never strike the ground, but occur between clouds or within the same cloud.

What can be done to minimize the potential of a lightning strike to an airborne aircraft? First and foremost, stay away from thunderstorms at any altitude. On occasions aircraft have received hits at altitudes as high as 38,000 feet AGL. Those innocuous cirrus tops can mask the anvil of a potent thunderstorm.

However, worldwide statistics indicate that aircraft can also be struck by lightning when in the vicinity of clouds not organized in a typical thunderstorm configuration. These situations are not fully understood and research into this area continues. Meanwhile AFR 60-16 prohibits USAF aircraft from flying horizontally within 20 nm of thunderstorms when flying at or above 23,000 feet, and within 10 nm below 23,000 feet. This is normally a safe separation distance. Flying under thunderstorms during landings or takeoffs can also invite disaster; not only from lightning but from turbulence, hail, ingested engine icing, gust front wind shear, and severe downdrafts.

STATIC DISCHARGES

Static discharges differ from lightning in the following ways. First, static discharges generally occur in clouds not considered to be thunderstorms. Secondly, the charge centers involved are smaller. In IFR flight, electrical charges are generated on the aircraft skin as it collides with small ice and water particles in the atmosphere. This charging phenomenon is known as triboelectric charging. Triboelectric charging increases with aircraft speed and affects all modern jet aircraft. The charge increases until the electric field around sharp curvature points on the aircraft is high enough to create an ionized path for a sparking discharge. High resistance materials such as windsheilds may also accumulate patches of charge. If these flash over to adjacent aircraft skin areas, a streamering discharge is said to occur.

The electrical capacitance of an inflight aircraft is relatively small, therefore, only a limited amount of charge can be accumulated. This charge will continue to build up on various areas of the outer skin of the aircraft until the local electric field rises to a value sufficient to produce discharge to the air. Normally this electrification is leaked or slowly discharged back to the atmosphere; however, instantaneous discharges a number of feet in length and accompanied by a sudden noise may be produced. These discharges are generally less violent than lightning, usually being orders of magnitude less in amperage, but occasionally being intense enough to cause instrument damage. Components such as transistors or integrated circuits can be destroyed by a static discharge. On-board computers can be scrambled and may read out erroneous information.

Triboelectric charging may also cause St. Elmo's fire, or the aircraft charge may bleed off invisibly to the air. In some cases, the electromagnetic radiation (spurious radio signals) due to small sparks produced by triboelectric charging may be coupled into the aircraft's antenna and cause static. This is often called "P-static" because it frequently occurs when the aircraft has charged itself by flying through precipitation.

Static dischargers, used to drain off the accumulated electrical charge on an aircraft without generating excessive radio noise, are a satisfactory solution to the P-static problem, however, they have no effect on the lightning problem. They can neither protect an aircraft from lightning nor reduce the probability of a lightning strike.

ST. ELMO'S FIRE

St. Elmo's fire derives its name from the patron saint of sailors. It was often witnessed as an eerie glow surrounding a sailing ship's masthead during stormy weather. As mentioned previously, St. Elmo's fire can also affect aircraft and can be seen as a corona discharge from the aircraft's wings, projecting parts, and windshields. It does not cause damage, but serves as a warning that the surrounding atmosphere is highly electrified and that lightning strikes may occur.

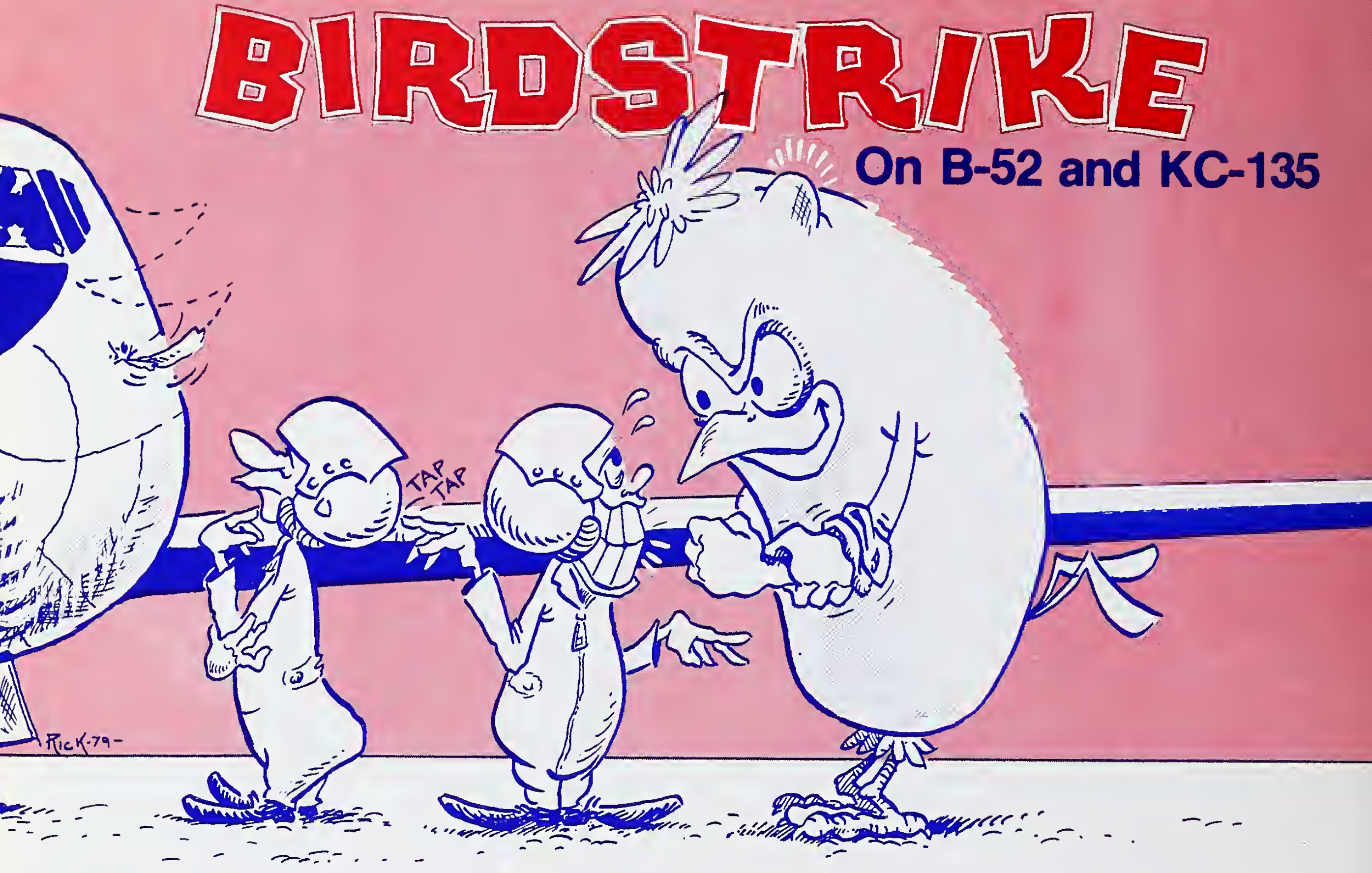
The corona discharge is caused by the electric field intensifying in the vicinity of a more or less pointed object. The charged particles moving in the electric field collide with and ionize some of the molecules in the immediate vicinity. This is an equilibrium process, and when some of the ions and electrons recombine, energy is released in the form of light.

SUMMARY

Our discussion has briefly touched on the major forms of visual manifestations of atmospheric electricity. Other manifestations such as ball lightning, sheet lightning, heat lightning, et cetera, are minor variations of the phenomena discussed. The discussion of lightning was intended to explain what causes an aircraft to become part of the electrical circuit, what meteorological conditions and altitudes favor lightning strikes to aircraft, and what general rules aircrews can follow to lessen the likelihood of their aircraft receiving a hit. The latter sections dealing with static discharges and St. Elmo's fire were meant to be informative in nature and perhaps dispel some of the mystery about atmospheric electricity.

BIRDSTRIKE

On B-52 and KC-135



Walt House
Boeing Service News

Seventy-five years ago this past December, man made his first powered, sustained, and controlled flight in a heavier than air machine and thus began competing with the birds for airspace. By 1911, the airplane had become "reliable" enough to enable Cal Rogers (with a little help from the railroad) to pilot the famous "VIN FIZ" across the United States. He traveled the 4,250 miles from the coast of New York to the coast of California between 11 September and 5 November, making thirty scheduled landings and surviving nineteen crashes. As the airplane became more reliable it also flew faster, making it more difficult for the birds to get out of the way. In the spring of 1912, Cal Rogers again made the headlines, this time as a statistic. A gull jammed the exposed control cables of his machine, making him the first recorded fatality resulting from an airplane crash caused by a bird strike.

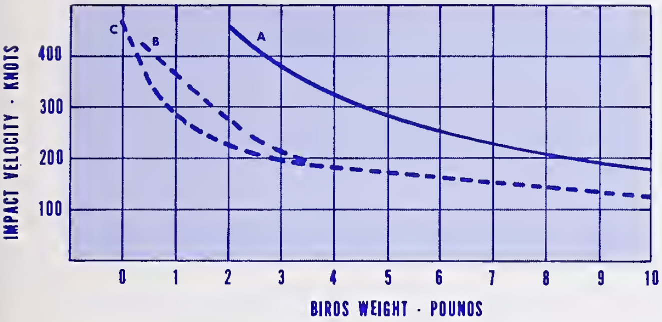
Since those early days the frequency of incidents involving bird strikes, along with the number of aircraft and the speed at which they fly, has steadily increased. Bird strikes are a hazard to both B-52s and -135s with the B-52 having a considerable edge. The altitude and speed requirements of the low level missions give the B-52 a high exposure rate to bird strikes with the strong probability that damage will result if a strike is incurred. One concern to B-52 and -135 crews is the lack of specific information pertaining to bird strikes and windshield penetration. As no controlled bird strike tests have been conducted on these aircraft, the only available data is from actual bird strike history and in the case of the B-52, calculations of bird strikes versus windshield penetration.

One fact that we do know is that several pounds of bird packs one heck of a big wallop when striking an airplane that is moving at a high speed. A look back at our high school physics will show us that our worst enemy is the speed, as the following formula for calculating kinetic energy bears out: Energy = ½ Mass X Velocity^2. A six pound goose generates a little over 9000 pounds of force when struck by an airplane traveling at 185 knots. This same six pound goose generates more than 36,000 pounds of force when struck at 370 knots. If the speed is doubled the force generated is four times greater. Fortunately all of this energy is not directly transmitted to the airplane. Some of it is absorbed by the "give" of the structure and a portion will be deflected by the angle of the structural surface relative to the line of impact. Many variables are involved in calculating actual impact forces and obviously will depend on the assumptions regarding the structure and properties of bird and aircraft and their behavior during impact. Different engineers may arrive at different figures, but all will probably agree that impact forces are impressive.

What will the windshields actually withstand? As

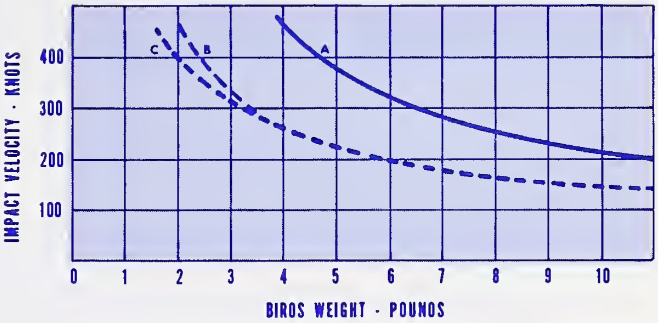
WINDSHIELD NO. 1 PENETRATION

(VELOCITY VS WEIGHT)



WINDSHIELD NO. 2 PENETRATION

(VELOCITY VS WEIGHT)



CURVE "A" — Represents bird weight and impact speed that will cause penetration of the bird carcass through the windshield when the vinyl of the windshield is at a temperature of 100° to 115°F (windshield heat on).

CURVE "B" — Represents bird weight and impact speed that will cause penetration of the carcass through the windshield when the vinyl of the windshield is at 25°F (assume power failure).

CURVE "C" — Represents bird weight and impact speed that will cause the inner pane to splinter or shatter (not appreciably affected by temperature).

NOTE: Reduce values given by curves A and B 44% for a birdstrike in the upper outboard corner.

mentioned earlier, no bird strike tests have been conducted on the B-52 or -135 aircraft but we do have a certain amount of information about them based on actual bird strike history and tests that have been performed on comparable installations in other aircraft.

The windshields for -135s (see BSN issue 323) are basically the same as those used on commercial model 707s. The 707 installation was tested and certified to resist without penetration the strike of a four pound bird at 390 knots. The tests were conducted with the windshield heated to normal operating temperature and without cabin pressurization. The structure of the -135 series windshield frame varies somewhat from that of the 707 but should withstand a similar strike.

The results of a bird strike study analysis of B-52 windshields No. 1 and 2 for penetration or shattering is presented here in graph form. Keep in mind that the information has not been verified by actual bird strikes. This data is based on comparisons between the B-52 windshields and comparable installations in other aircraft on which actual bird strike tests were accomplished. From the data in the two graphs, it is possible to determine the velocity and bird weight that will result in probable windshield penetration or shattering. Note the effects of temperature on the vinyl inner layer. Curve A on the graph represents the velocity vs bird weight necessary for windshield penetration with windshield heat on (vinyl inner layer 100° to 115° F) while curve B is without heat (25° F, assume power failure). Curve C depicts the velocity vs bird weight that will cause shattering of the inner pane. Vinyl temperature does not appreciably affect curve C but does affect the ability of the windshield to resist penetration. Windshields (with heat on) have been reported to protrude inward as much as four inches after a strike. Even though both the inner and outer panes were shattered, the vinyl inner layer did not allow penetration. These calculations have not been worked out for the -135s but the vinyl temperature will have the same effect on them.

The bird strike statistic charts furnished here depict a very high number of strikes in the area of the traffic pattern. This is particularly noticeable on the -135. Although the B-52s had most of their strikes during low level missions, a considerable number did occur close to or on the runway. This tells us that bird control on and around the airdome could save a sizable amount of that being spent for repair of bird strike damage. Note that the greater number of strikes ended up in the area of the engine or cowl. More than half of these were ingested into the engines resulting in engine removal and some type of field repair or overhaul.

Continued on page 18

OPS — UP-DATE

HQ SAC DCS/OPS

MAJOR GENERAL JACK L. WATKINS

DIRECTORATE OF COMMAND CONTROL, SPACE AND SURVEILLANCE — COLONEL CLARENCE R. AUTERY

STANDARDIZATION DIVISION — Hq SAC's Command and Control, Space and Surveillance Directorate includes DOCVS, better known in unit command posts as Stan/Eval. The Evaluation Branch conducts standardization/evaluation visits to all SAC units possessing command control facilities. The team administers simulated EWO tape examinations to all available controller teams at each level of command, including Hq SAC, numbered air forces, airborne command control squadrons (ACCS), as well as unit command posts. The purpose of this method of evaluation is to determine the depth of controller knowledge and at the same time evaluate the effectiveness of the local training program. Each controller is also required to take a closed book examination on SAC command control procedures and an open book force management test. Other items the team looks at during this one day inspection are aircrew training, admin security, checklists, operating instructions, force management, and areas of special interest to Hq SAC. (Col George Grassan, DOCV)

CHECKLISTS — Through the years, checklists have proven their value in many professions, even to the point of saving lives, but these valuable tools have also been abused. People have sometimes neglected to learn the substance of their duties and, instead, just "learned the checklist." Instructors have made the checklist into a lesson objective rather than a tool to be used in the accomplishment of a task. But like any other tool, a checklist is only as good as the person who uses it. It is with that person in mind that Emergency War Order (EWO) checklists are built in the SAC Emergency Actions Division. The crew member or controller may be called upon to perform many intricate, time-sensitive tasks while under great pressure. Because no checklist can be written that would cover every conceivable EWO situation, it is our job to prepare checklists to assist a trained individual in accomplishing the correct actions. Only the user can ultimately insure successful accomplishment at these critical times. (Capt William Perkins, DOCC)

DIRECTORATE OF STRATEGIC RECONNAISSANCE CENTER — COLONEL HARLON A. HAIN

TESTING THE FUEL SAVINGS ADVISORY SYSTEM (FSAS) — Computers have long been used by navigators and ravens, but now a new performance system is being tested in RC-135 aircraft to aid the pilots in their duties. Pilots have always used rules of thumb to keep from digging out the dash one to obtain performance data. Sayings such as "divide the distance by mach, etc., etc." will soon go the way of the silk scarf and jodhpurs. This computer will eventually store and present all the data, including three engine, presently in the performance section of the dash one — from take off, through climb, cruise, endurance, descent, approach, and even such information as optimum altitude, time and fuel for an alternate, if you have to "take it around." The old slipstick will also start gathering dust as the FSAS will figure CG and present a current display of present MAC. A prototype FSAS has been installed in one RC-135V. The results of initial testing have indicated a fuel savings in excess of five percent on refueled missions longer than 11 hours. The next phase of testing will be on shorter unrefueled missions and fuel savings are expected to be even greater. Captain Larry Hungerford of the 38 SRS, one of the pilots who tested the system, was highly impressed with its capabilities. This is one positive action that SAC is taking to get more miles per thousand pounds of fuel. A timely program in light of the present fuel crunch. (Lt Col Chris McAloon, DORO)

DIRECTORATE OF OPERATIONS — COLONEL GEORGE P. TYNAN

SAC'S MINING MISSION — The use of aircraft in an aerial mining role is not a new concept. In WW II, B-29 Superfortresses planted over 12,000 mines in Japanese home waters during the highly successful "Operation Starvation." However, it was not until 1947 that the Air Force was formally assigned a collateral maritime mining mission. The B-52D's range, precision navigation, weapons delivery accuracy, and capability to deliver large weapons payload, make it ideally suited for a mining role. These characteristics, combined with increased command activity in contingency operations, have currently resulted in more emphasis being placed on B-52 mining than at any other time in SAC's history. A visible sign of this emphasis is SAC's mining operations during NATO exercises. The mining capability of the B-52D was first demonstrated in TEAM WORK 76 when bombers from Carswell AFB TX, flew a simulated mining mission in the Baltic Sea area and later when two mining missions were flown in Europe for NORTHERN WEDDING 78. Future plans will involve further mining activity in NATO exercises and an exercise drop in the Western Pacific. The suitability of the B-52D for delivering mines will insure that mining remains an important SAC mission. (Maj Carlton Blase, DOOCX)

BUSY LUGGAGE — The 320 BMW (Mather AFB CA) will conduct a BUSY LUGGAGE flight test mission on 11 Jul 1979. During the mission, the fifth of six missions planned for the CY 79 program, two inert test weapons will be released from low altitude on the Tonopah Test Range, Nevada. (Maj George Whipple, DOOV)

BULLET BLITZ — On 18 July, a crew from the 28 BMW, Ellsworth AFB, will accomplish the twelfth live SRAM launch in the current series of BULLET BLITZ tests. The B-52H aircrew will program the missile to fly a semi-ballistic profile to a target located on the White Sands Missile Range NM. The SRAM will be configured with an Operational Test Launch payload containing a beacon transponder to permit missile tracking by ground radar, a telemetry package for transmission of missile performance data, and a command/destruct capability for safety purposes. (Capt Steve Leonard, DOOV)

DIRECTORATE OF WEATHER — COLONEL ALFRED C. MOLLA, JR.

WEATHER BRIEFINGS — It is imperative that the departure base weather forecaster knows the planned flight profile. Changes in altitude and the practicing of approaches enroute to the final destination can mean changes in expected weather. For your safety, insure your weather forecaster knows what you plan to do and your briefing will be tailored accordingly. Equally important, if a flight plan is modified while airborne, contact a PMSV and get a thorough update briefing. (Lt Col John Sweeney, DOWE)

DIRECTORATE OF MISSILES — COLONEL JOE L. CHURCH

MINUTEMAN CODES CONFERENCE — The Headquarters SAC, Directorate of Missiles recently hosted the annual MINUTEMAN Codes Conference. The conference provided personnel involved in the development, management, and control of SAC's MINUTEMAN Launch/Code Systems an opportunity to discuss current and future coding operations, code control procedures, and improvements in the management and control of SAC's ICBM launch control/code systems. (Lt Col Wiley Riner, DOMC)

MINUTEMAN/TITAN SACMET STUDIES — The MINUTEMAN Study (51 additional officers) and the TITAN Study (an additional 79 officers and 75 enlisted) have been approved and are awaiting funding. Implementation could be as early as Oct 79, or as late as Oct 81. (Maj Wendell Brande, DOMM)

DIRECTORATE OF TRAINING — COLONEL JOHN J. DORAN, JR.

SAC DO CONFERENCE (BUSY PREVIEW II) — Recently, we held a conference for SAC missile/flying unit, air division, and numbered air force DOs at SAC Headquarters. Conferees discussed GLOBAL SHIELD preparation, M-X, "Stretch FB-111," safety, personnel retention, ORI scoring, alert force survivability, and B-52 training. Specialized workshop sessions addressed missile and reconnaissance topics. NAF/DOs chaired conferences to discuss their NAF's areas of interest. The highly successful conference provided an ideal forum for SAC's senior operations managers to work key operational issues as a group and with the SAC staff. (Capt Bruce Eickhoff, DOTT)

SAC BOOM OPERATOR AIR REFUELING CONFERENCE — Inflight refueling superintendents from throughout the command, 4200 TES, AF Flight Test Center, and AFMPC recently held an air refueling conference, the first of its kind, at Offutt AFB. The purpose of this working level group was: (1) Identify and resolve training problems associated with significant increases in KC-135 operational commitments to lateral commands, reduced flying hours, safety, and a much younger crew force; (2) Improve the management structure of the inflight refueling career field (112X0) by outlining specific duties/responsibilities of the squadron staff boom operator position which is a pending manning authorization; (3) Review resource selection policies; and (4) To discuss projected EC/KC-135 aerial refueling system improvements. Conferees received numerous specialized briefings which included: air refueling testing and evaluation, inflight boom simulation, boom operator station improvements, instructor upgrade program, and resource selection. Additionally, an update briefing was given on the latest developments pertaining to the Advanced Tanker Cargo Aircraft (KC-10). (CMSgt Lester Ringler, DOTTA)

OPS UP DATE

DIRECTORATE OF COMMAND CONTROL, SPACE AND SURVEILLANCE – COLONEL CLARENCE R. AUTERY

Welcome to THE SAC COMMAND POST

"On behalf of the Commander in Chief, Strategic Air Command, welcome to the SAC Command Post!" Well over 16,000 visitors to SAC Headquarters last year heard that introduction to SAC's Underground Command Post tour. In this article you will "see" the SAC Command Control briefing, minus — unfortunately — the awe-inspiring photographic and artwork support accompanying the presentation in the Command Post itself.

The approximately 45 minute briefing conveys to visitors how SAC performs its vitally important Command Control mission. During their brief exposure to this mission, visitors are introduced to each of the eleven Command Post console positions, given an overview of Command Control at the national level, and then presented an in-depth view of the SAC process.

SAC views Command Control as a dynamic process consisting of an inward flow of information and an outward flow of directives to SAC units and alert combat crews. These relationships are brought to life via a dramatic original artwork slide flooding one of the 16′ x 16′ wall screens in the SAC Command Post.

Transitioning then to a closer look at the inward flow, visitors are shown the flow of force status information from SAC units through displays on the large wall screens. Included is a look at several of the over 600 preformatted force status displays.

Following the second source of incoming information, intelligence or strategic warning, the visitor is exposed to SAC applications to tactical warning. Included is an introduction to the sensor systems of the North American Aerospace Defense Command (NORAD), and the SAC Warning and Control System (SWCS) which processes and displays data from the NORAD sensors.

To introduce the outward flow of directives, the briefer emphasizes two things: first, functionally redundant communications systems required to assure message receipt by the crew force and, second, positive control procedures which assure precise crew response.

Assuming that a hostile missile attack was launched against the United States, a Presidential directive to respond would be transmitted via the Joint Chiefs of Staff Alerting Network (JCSAN). Visitors are shown how this message would be simultaneously received by SAC's Underground and Airborne Command Posts, and immediately patched to field units through SAC's own command control structure.

SAC uses its Primary Alerting System (PAS) as the prime medium for transmitting voice directives. The PAS provides two capabilities. One circuit permits a two-way hot line conversation with individual units. To demonstrate, a member of the Emergency Actions Team activates this system and says, "Eielson, SAC." Virtually instantaneously, they reply: "Roger, SAC, this is Eielson." Visitors on SAC's Command Balcony are then treated to a weather summary from the "land of the midnight sun."

SAC uses the "red phone," on the other hand, to simultaneously transmit directives to over 200 locations. Visitors are shown displays of one of the 153 alert missile crews copying the SAC broadcast and a unit command post team acknowledging receipt to SAC and then relaying the message to alert aircrews over the base-wide radio system.

An invitation is then extended to watch a demonstration of the system. With curious anticipation, the visitors lean forward and peer down upon the console team below. The Officer Controller picks up the red phone and transmits, "Skybird, this is the SAC Command Post with a test of the Primary Alerting System — acknowledge now."

At the command to acknowledge, each unit command post in the field depresses a push button on their console causing acknowledgement lights

The Combat Control Division's Graphic Arts Section provides the outstanding graphics and photographic support which animate the story of SAC Command Control.

on SAC's red PAS panel to extinguish nearly simultaneously. There is no doubt left in the visitor's mind that SAC has instant voice communications!

SAC uses several radio systems to insure survivability and to communicate with airborne forces. Systems have been selected to complement one another.

The Survivable Low Frequency Communications System (SLFCS) is relatively invulnerable to atmospheric interference. Additionally, ground transmitters are backed up by the SAC Airborne Command Post (ABNCP) aircraft which can reel out a long trailing wire antenna and transmit emergency action messages.

For long range transmissions to airborne forces in particular, and to missile crews as well, SAC uses the high frequency (HF) GIANT TALK system. Though HF is susceptible to interference and jamming, this system provides good communications in a non-stressed environment.

The ultra-high frequency (UHF) GREEN PINE system passes traffic to overflying aircraft. The net control station at Elkhorn, Nebraska, receives messages from SAC and then relays them via landline, microwave, and satellite communications to the remote GREEN PINE sites strung out across the northern tier of North America.

To demonstrate this system, the briefer asks the visitors to select three or four sites. The Communications Controller then polls those sites. No doubts of system reliability remain after this live demonstration!

This look at radio communications concludes with the Emergency Rocket Communications System (ERCS) which consists of Minuteman missiles into which either the underground launch control centers or the SAC ABNCP can record messages and then launch the missiles on designated trajectories.

During a rapidly building missile attack, SAC Headquarters would activate alerting devices at SAC bases. Missile crews would immediately take action to further enhance their alert configuration. Aircrews would respond to their aircraft, start engines and, after authenticating the directive to launch, take off. SAC bombers would air refuel and then proceed to their Positive Control Turnaround Points (PCTAP) and await either recall or authority to strike assigned targets.

Following the pictorial look at the positive control launch scenario, nuclear execution procedures and safeguards are presented for both bomber and missile weapon systems. Emphasizing safeguards is not a mere concession to the "control" aspect of Command Control. Rather, SAC feels it is of paramount importance to assure citizens that nuclear weapons will not be used without proper Presidential authority.

While acknowledging the inherent vulnerability of a ground based Command Control system, the briefer next introduces PACCS — the Post Attack Command Control System.

First the visitors are shown a cutaway look at the M-2 SAC Airborne Command Post, followed by a live "mission briefing" presented by a member of the Airborne Battle Staff. During this "demo," a photograph of the current Airborne Emergency Actions Officer (AEAO), with his battle staff (on board an ABNCP aircraft), is displayed on the large wall screens. The AEAO is a SAC general officer of general officer selectee who is prepared to take over command and control of SAC forces.

Unlike the 18 years of continuous airborne alert credited to the ABNCP, the other seven elements of PACCS are on ground alert. Two of these aircraft are Auxiliary Airborne Command Posts (AUXCP). The AUXCPs augment airborne battle management capability by taking approximately twenty additional battle staff personnel into the airborne posture. The Airborne Launch Control Centers (ALCC) are three EC-135 aircraft equipped to launch Minuteman missiles should ground crews be unable to do so. Finally, there are two radio relay aircraft whose missions are to go airborne to link the entire SAC PACCS with the National Emergency Airborne Command Post (NEACP).

The Command Control tour concludes with a look at how SAC fits in the "big picture" — the Worldwide Military Command Control System — and with a glimpse at some future concepts in Command Control. One such development is AFSATCOM I, a satellite-borne communications system that will significantly enhance UHF connectivity with SAC forces. Another is the E-4B airborne command post program (the E-4A, a specially equipped Boeing 747 airframe, currently supports the NEACP mission).

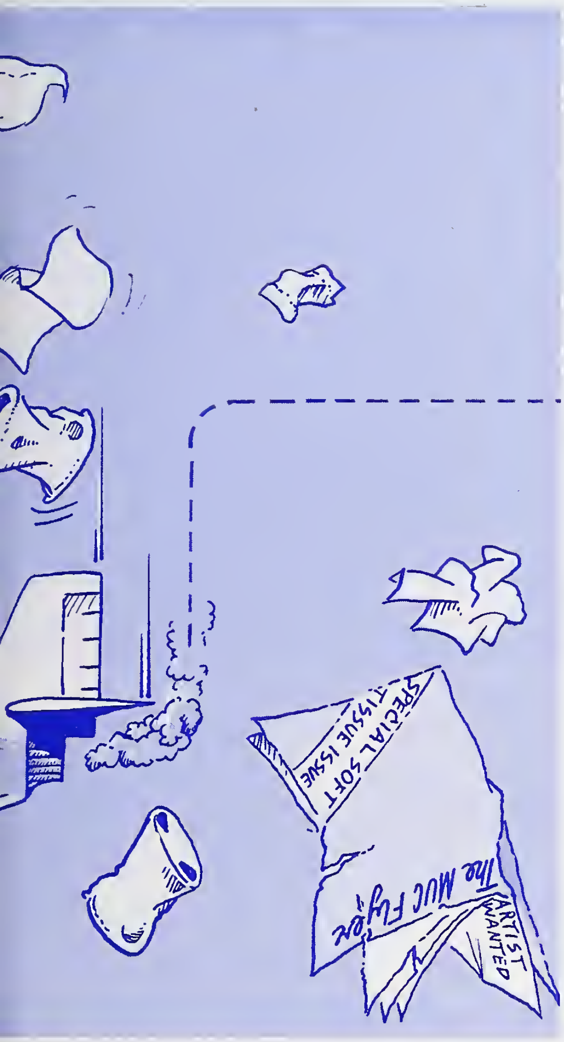
It is rare that a visitor does not leave the Command Balcony with a positive feeling about SAC's ability to execute its Command Control mission. The SAC senior staff is proud of these presentations and wishes the message could go out to many more people each year. It remains vitally important that the taxpayers, their elected representatives, our lateral commands and agencies, our allies, and other interested parties understand our charter and know that we are effectively and efficiently accomplishing that mission. (Capt James F. Bryden, DOCS)

An Inquiry into

Capt David Christensen
28th Bomb Wing, Ellsworth AFB

Windshear has been named as the heavy in many mishaps during the last few years, both on takeoff and landing. Vertical windshear is well recognized and understood, but the effects of horizontal windshear are often not understood, nor clearly explained.

Let's examine wind speed and its association with airspeed. Actually, wind can best be explained as a force acting upon an aircraft rather than a velocity over an aircraft's wing; positive, negative, or lateral. When an airplane flying a course does not allow for wind, it is displaced (drifts) an amount equal to the force that is applied to it. When an airplane takes off on a no-wind day, it takes a certain amount of force to accelerate it to a takeoff speed. If it takes off into a headwind, to even begin moving forward, there must be sufficient power to overcome the force of the wind holding it back. During a downwind takeoff a negative force in the form of brakes must be



applied to hold position prior to the takeoff roll. After releasing the brakes in the latter case and adding the same amount of power as in the no wind case, the aircraft accelerates to liftoff speed faster by a factor of the tailwind. The indicated airspeed in all these cases is always the same. An airplane that flies at 100 knots IAS flys at that speed regardless of the ground speed.

What happens when we cross a shear line and immediately change from a 20 knot headwind to none at all?

If we believe that airspeed contains a factor contributed by wind speed (wind blowing into the pitot tube), the airspeed of our theoretical aircraft will fall by the amount of wind change, or gain in the opposite case, and probably stall out. Fortunately for generations of flyers, the airspeed indicator only measures the speed at which the aircraft is moving through a moving sea of air, not how fast that sea of air is moving the aircraft. When our airplane is flying into a 110 knot headwind at 100 knots, the airspeed indicator reads 100 knots not 110 knots or-10 knots. Speed is relative to the moving system rather than a stationary system. Therefore, when the wind suddenly stops, we do not fall immediately to the ground due to lack of kinetic energy or airspeed. The airplane continues on its way with the only bumpiness that is always present at marked discontinuity lines. Since the whole airplane drifts at the same speed as the air mass around it, then it is impossible for the pitot static system to measure that velocity. Therefore, it cannot be affected by changes in velocity. Of course, changes in the amount of force being exerted on the aircraft will affect the acceleration which it experiences, i.e. in the face of an increasing headwind, it will decelerate, or into a decreasing headwind, it will accelerate. These accelerations will be in relation to the aircraft's velocity through the air mass as we have seen previously, not in relation to its ground speed.

Now that we know what does not have an effect on horizontal windshear problems, let's look at two things which do have an effect. First, let's look at two techniques for holding airspeed and vertical velocity on final approach. The proper vertical velocity insures arrival at the touchdown point and not halfway down the runway or 2000 feet short of the overrun. The proper airspeed prevents stalling out and landing miles short. There are two schools of thought on controlling these two factors on an approach. One theory is to control airspeed by adjusting power and vertical velocity by adjusting pitch. The more exacting and recommended method is to control airspeed with pitch and vertical velocity with power. Since less experienced pilots use the former rationalization, the hazards of windshear present a special problem to them. When a large aircraft descends through a windshear on final approach, part of the aircraft is in one air mass and part is in the other. The two opposing forces tend to cause a turning movement about the center, formed by the two forces pitching the aircraft up or down depending upon the wind directions. A B-52 descending from a 30 knot tailwind to a 30 knot headwind will be pitched downward as the headwind forces the nose down and the tailwind forces the tail up. Of course the opposite would happen if the B-52 descended into a tailwind or if it descended from a headwind to a no-wind condition. But let's examine the first case as it is the most likely problem area to be encountered.

For the sake of argument, we will use speeds which are unrealistic for large aircraft but convenient to the author. Consider a large aircraft departing the 10 mile final approach fix at 90 knots IAS on

Continued on page 21

AIRBOR

Capt William T. Tuttle
93d CCTS

Some questions an instructor should ask before flying with a student the first time are: 1) How well do I know my student? 2) What is the student's previous aircraft, total time and time in present position?

The homework you do before flight can point out possible conflicts between past experience and future requirements.

The KC-97 to KC-135 conversion program provides just one such example. The KC-135 stab trim switch is located on the left side of the pilot's yoke, right where the KC-97 pilots had their interphone button. Such switch location differences between aircraft can be hazardous to your health. Perhaps the following incident will prove enlightening or frightening.

The mission was the first for the pilot in the left seat. Remember the similarity in switch locations; add the wet-thrust noise, vibration and dim cockpit lighting; mix well with night, VFR conditions, and fatigue from day time duties; sprinkle lightly with patchy snow and snow lightly blowing across the landing lights, requiring more than the usual outside concentration for takeoff; clinch it with a 7000-foot long runway and critical field length to match. Now you have the recipe for what followed.

Whether you be a left-seater or a right-seater, place yourself at the controls of the aircraft performing the copilot duties during the takeoff roll: Where are your feet, hands, and eyes? And if you are a crewmember not at the controls — how watchful are you? Just passing S1 the aircraft became airborne despite downward yoke pressure. This was probably caused by unnoticed stab trim being applied by the pilot who was reverting to the KC-97 memories. Instead of the familiar interphone button, he was using the stab trim button.

Finding the aircraft 50 feet in the air and 20 KIAS below rotation speed, the instructor had no choice but to push over and accelerate straight ahead. No runway markers available at this field, but even had they been there, all they could have said is "too late." Fortunately, the aircraft missed all the high power lines and television antennas in its flight path. The

NE AT S1

remainder of the mission was "uneventful," but no one breathed a sigh of relief until the aircraft had safely landed, taxied past the six-foot snow banks and into the parking stub.

What can we all do to prevent similar situations? Our planning should start early. Know the strengths/weaknesses of all crew positions. Instructors, find out what impact your students' previous flying experiences will have on your training program. Are there conflicts in switch positions? Even the move from right-seat to left-seat will cause minor problems. Anticipate!

Having completed all your homework, what habit patterns can we develop to enhance Dash One procedures? Let's go back to two questions posed earlier. Pilots monitoring throttle during takeoff roll — where are your hands, feet, and eyes. All other crewmembers — what are you watching, hearing, or monitoring?

For tanker pilots, a fail-safe technique of monitoring runway stabilizer trim during takeoff roll from the left seat is to guard the throttles with your palm down, thumb stretched forward and resting on the trim wheel with fingers pointed at the pilot making the takeoff. If in the right seat, place your fingertips on the stab trim wheel. Any motion of the stab trim will be immediately detected, despite darkened cockpits or the roar of the engines at TRT. A real side benefit, the unscheduled wheel movement will surprise you and cause your hand to jump up, ready to pounce back down and stop the runaway.

If the takeoff is committed, you will easily have stopped the inadvertent trim change within tenths of the correct setting. Reach over with your other hand and use the cutout switch, if required. The pilot at the controls will be able to make normal rotation and climbout. Once safely airborne, cleaned up, and at a good cruise altitude, refer to Dash One.

All crewmembers must monitor their instruments and those "up front" during critical phases of flight. Pilots at a set of controls must be ready to fly the airplane at a moment's notice or without notice!

BIRDSTRIKES

Continued from page 9

BIRD STRIKES VERSUS PHASE OF FLIGHT

	B-52	-135
LOW LEVEL	118	N/A
TRAFFIC PATTERN	41	97
UNKNOWN	4	12
IN FLIGHT OTHER	19	29
TOTAL	182	138

NOTE: BIRD STRIKE DATA IN BOTH CHARTS IS FROM 1975 THRU LATE 1978

BIRD STRIKES VERSUS IMPACT AREA

	B-52	-135
ENGINES & COWLING	*62	80
WINGS & FLAPS	57	37
FUSELAGE & RADOMES	42	14
WINDOWS	10	1
EMPENNAGE	7	1
EXTERNAL TANKS	0	N/A
LANDING GEAR & LIGHTS	2	3
UNKNOWN	7	2
TOTAL	182	138

*OVER HALF OF THESE OCCURRED DURING TRAFFIC PATTERN PHASE OF FLIGHT ON B-52

Bird control can be very complicated and frustrating but the basics are simple and very fundamental. Reduce the availability of the things that make the vicinity of the runway attractive to birds, such as food supply, water, cover, and freedom from attack, and the bird populations will be drastically reduced. Do the areas between the runways drain properly or do ditches and depressions remain full of water for long periods after rains? Is the grass kept at a length as to obstruct the view of small to medium size birds so that they feel uneasy from not being able to see their attackers? Are large numbers of hawks and owls attracted because the grass is tall enough to allow rodents to flourish? Is food in abundance because part of the land is leased to a farmer who grows a crop that is attractive to birds? Answers to these questions may indicate where some of the problems lie.

The geographical locations and altitudes where birds may be encountered vary with the season, weather, and species of bird. More strikes occur during the spring and fall migration periods. Statistics show that the strike frequency is usually a little higher in the fall. The fall migration involves more birds and there is also the theory that there are more inexperienced birds at this time and they don't get out of the way as easily. Several wildlife agencies have published bird strike statistics and all agree in that most strikes take place below an altitude of 3000 feet asl (above sea level). There are extremes to this. The highest recorded bird strike altitude is 37,000 ft. asl by an El Al airliner and an unidentified bird. In the U.S. a civil aircraft struck a Mallard duck at 21,000 ft asl over Nevada.

As a comforting note we find that there are no recorded windshield penetrations on either the B-52 or -135 series. Granted there have been cabin entries through the adjacent structure or secondary windows but not through the windshields. There is also evidence that the B-52 birdstrike vs windshield penetration charts are more on the conservative

side. One recorded strike by a B-52H during a low level mission occurred at 380 KTAS (Knots True Air Speed). The remains of the bird were identified at a nearby college as being a Canada Goose weighing 9 to 10 pounds. A quick check on the chart shows this to exceed the load limit of the pilot's No. 2 windshield. In this case both the inner and outer glass panes were shattered but the vinyl layer, even though displaced inward several inches, did not fail and allow penetration. In a similar incident, the vinyl inner layer was reported to have protruded inward four inches, again without failure.

Reports on evasive action taken by the pilot and/or bird are few, as most strikes occurred without prior visual contact. In all reports where the bird was observed to have seen the airplane prior to the strike or near miss, the bird always used his last ditch maneuver of a wing folding dive. In some instances this was a bad move, as the dive was executed while the bird was slightly above the airplane and resulted in doing a cannonball into some part of the airframe. All reported successful evasive actions taken by the pilots consisted of a rapid pullup and in some cases a turn away from the bird. What is termed as successful is that the bird was either missed or struck the lower portion of the airplane.

We can conclude that with the right combination of speed and bird weight, windshield penetration is possible. There are two simple steps that can be taken to prevent a serious accident as the result of a bird strike. (1) Keep the windshield anti-icing heat on. This keeps the vinyl inner layer warm and flexible, enabling the windshield to withstand considerably greater impact force without penetration. (2) During low levels, takeoffs, and landings wear helmet visor(s) in down position as visibility permits and mask on. In the event that the windshield is penetrated during a strike, the visor(s) and mask can reduce serious injury to the crewmembers and possibly preclude the loss of control of the airplane.

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CFIC Corner

GETTING THE MOST FROM THE T-10 TRAINER

Capt William D. O'Brien
CFIC B-52 IRN
Castle AFB, CA

Ever since the Strategic Air Command began flying bombing missions, the name of the game has been to bomb reliably and fly safely. There have never been sufficient flying hours available to give crewmembers adequate inflight training, but crews can improve upon their inflight training and better their chances of flying safely and reliably by taking advantage of their time in the T-10 mission trainer. The T-10 provides excellent training to supplement inflight activity. That sounds great, I know, but how many times have you sat in the T-10 and wondered exactly why you were there, and what it was you were supposed to be doing. The "Wednesday afternoon on alert T-10" has become a much maligned creature to bomber Nav teams. Much of the criticism is justified, but if we pause to examine the T-10, we may find new purposes in this old workhorse. Let's take a closer look at why we have the T-10 trainer, what we can expect from it, and how to prepare for a successful T-10 mission. I'm sure we can come away with a better attitude toward this venerable machine. Even though the Weapons Systems Trainer (WST) is on the way, the T-10 will still be with us for some time to come.

Until the WST becomes fully operational, the T-10 mission trainer will continue to provide an excellent atmosphere to sharpen your skills as a navigator or "Bomb Aimer". Honing your skills in the T-10 will make you a more competent, professional, and safe crewmember. Properly utilized, the T-10 provides excellent training to B-52 navigators and radar navigators, at great savings of time, money, and wear and tear on aging airframes. Realize that the T-10 cannot perfectly duplicate inflight conditions, but it does provide an atmosphere conducive to practicing crew coordination, pacing, and checklist operations. The T-10 gives us a great opportunity to refine our navigation and bombing skills, and improve our SRAM programming and launch procedures. It is the perfect place to practice new techniques which we would otherwise hesitate to try in the air. While the T-10 won't necessarily lower your bombing circular error, it will certainly help you to stay reliable, which is really the "bottom line". The trainer allows units to dry run their game plans for EWO, contingency, and higher headquarters directed missions, greatly reducing the chances of encountering unwelcome surprises after the klaxon sounds. Finally, the T-10 gives us the opportunity to conduct certain SACR 60-4 evaluations and give corrective training without the expense of additional flying hours. So, if you pause and reflect, there really are many reasons for the T-10. It's not just a place to spend your time on alert, whether you want to or not.

Although the T-10 has many various and worthwhile uses, it is important not to expect too much. While the trainer simulates the aircraft, it is not the aircraft; neither is the environment truly an inflight environment. Realize the limitations of the T-10. Video presentations are artifically produced and cannot perfectly represent inflight radar returns, so don't plan to use the trainer for target study. You'll probably find yourself in the air, looking for things that don't exist. Concentrate on pacing, checklist operation, and crew coordination. Don't pay lip service to procedures involving equipment not designed to function perfectly in the trainer, such as the MD-1, the rendezvous beacon, or SRAM present position. Try to work around malfunctioning equipment. Wouldn't you do the same thing in the air? Even though you understand the purpose of the T-10, and work within the system's capabilities, you won't attain maximum benefits from the trainer unless you properly prepare for each trainer mission.

To emphasize the importance of sound preparation for a trainer mission, let me ask you a question. Have you ever figured out what you are supposed to be doing about half-way through the trainer period? The truly professional crewmember would not fly a mission unprepared, but we have all had the tendency, at one time or another, to enter the T-10 stone cold. Surely, we can get much more out of the T-10 by putting a little more mission planning into each period.

Before you begin your T-10 period, take a little time and effort to plan what you will be doing. Get together with your trainer instructor prior to the mission to get an idea of what type profile you will be flying, whether it be a SACR 50-24 profile such as a BNS-4, multiple bomb runs, a celestial navigation leg, or whatever. Get to the trainer early, if at all possible. A thorough prebrief is essential to a successful mission. Cover the mission profile before you enter the trainer itself and you'll be able to spend your time accomplishing, rather than wondering what you're supposed to accomplish. Once you get into your seat, make sure that everything is properly positioned and that you are comfortable before you actually start the trainer. It's difficult to start cold and you don't get any extra points for finishing five minutes earlier. Finally, have an alternate mission plan in mind in case the trainer maintenance status precludes flying your original game plan. If you take these steps to prepare for a trainer mission, there is much less chance you'll be wasting your time.

Speaking of time, remember that the trainer does not end when you leave your seat. Take a few minutes to get a good, thorough critique from the instructor. A conscientious and knowledgeable instructor can really help you improve your performance. Keep in mind that the IRN is not there for his own benefit. He's there to help you.

Although the T-10 mission trainer has many faults, it also has many advantages; you can't beat the training for the price. It is an excellent *procedural* trainer. Knowing why you're in the T-10, taking the trainer for what it is, a training aid, and knowing what you plan to do while you're in there will greatly improve your ability to navigate and bomb, and to do so safely. It's your time. Make the most of it.

WINDSHEAR

Continued from page 15

a no-wind day. It will take six minutes 40 seconds and a descent rate of 480ft/min. to land at the instrument touchdown point. But what happens on a day when there is a windshear at our altitude five miles from the end of the runway?

The aircraft departs the final approach fix with a 30 knot tailwind on airspeed at 90 knots IAS. This gives the pilot a ground speed of 120 knots which will bring the aircraft to touchdown point in five minutes. However, the pilot is concerned with maintaining the glide slope which will take 635 ft/min (3.0 degree glide slope). At this point, the landing is wired, power back, and a perfect landing assured. Two and one-half minutes later, the aircraft hits the windshear. The mathematics of the new situation are a ground speed of 60 knots, five minutes to go to the runway, a descent rate of 320 ft/min, and the necessity of adding power to overcome the force of the headwind and make up for the boost the tailwind was giving him.

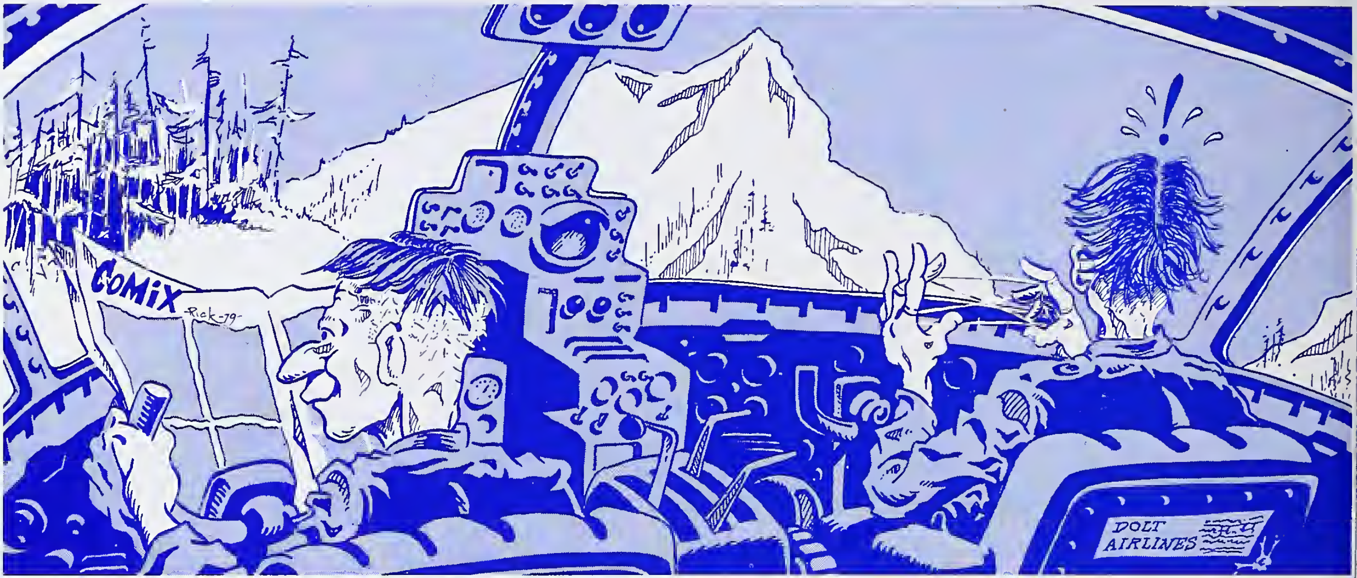
What actually happened?

The aircraft pitches down due to the torqueing movement. The vertical velocity and airspeed begin to increase while the aircraft rapidly drops below the glide-slope. For the pilot controlling airspeed with power, a serious problem exists. This flyer is going to pull back the throttle even further than the already too low setting in use. The aircraft will arrive at a position from which spoolup time is insufficient to save a stall. The pilot that raises the nose to control increasing airspeed is moving in the correct direction both to regain the proper airspeed and also to get back to the proper glideslope/vertical velocity. This pilot will discover a need for more power to decrease the glideslope, even more than he expects. A roughly analogous situation, but opposite to that shown above, exists when crossing from a headwind to no-wind situation. After examining the mechanics of this typical landing situation, it is easy to see why a pilot might feel as though the airplane is falling out from under him. But the key is to just ride the problem through by lowering the nose rather than responding with excess power, and the landing will be at the planned touchdown point.

Windshear of any type can have catastrophic effects upon the unwary pilot or the aircraft whose parameters of safety are exceeded.

Every pilot should periodically reexamine what he thinks is true about the way his aircraft flies, and decide whether everything he's been told is fact or wishful thinking about the situations in which we find ourselves in everyday flights.

OPS HAZARDS



"NOT ME . . . . I THOUGHT YOU WERE"

SECOND IN COMMAND?

The pilot's "complete lack of awareness" of his airspeed and descent rate and his aircraft's go-around capability caused a runway overrun crash, the National Transportation Safety Board reported.

Contributing to the mishap was the copilot's failure to provide required callouts which might have alerted the pilot to the airspeed and sink rate deviations. The Board said it could not determine "the reason for the pilot's lack of awareness or the copilot's failure" to make required speed and altitude callouts.

The aircraft technically was making an instrument approach, although the pilot actually was flying visually in the clear, late afternoon weather. The runway was dry. The aircraft overran the runway by more than 700 feet, shearing its landing gear as it crossed a 10-foot deep drainage ditch. One passenger was seriously injured and eight other passengers and a flight attendant were slightly injured. There was no fire.

Safety Board investigation showed that the ground proximity warning system had sounded three times during the aircraft's approach — all triggered, at least in part, by excessive descent rates. The Board said the flight's average rate of descent was 1,240 feet per minute during the final 4.8 miles of the approach. It was 2,375 feet per minute at 510 feet above the ground.

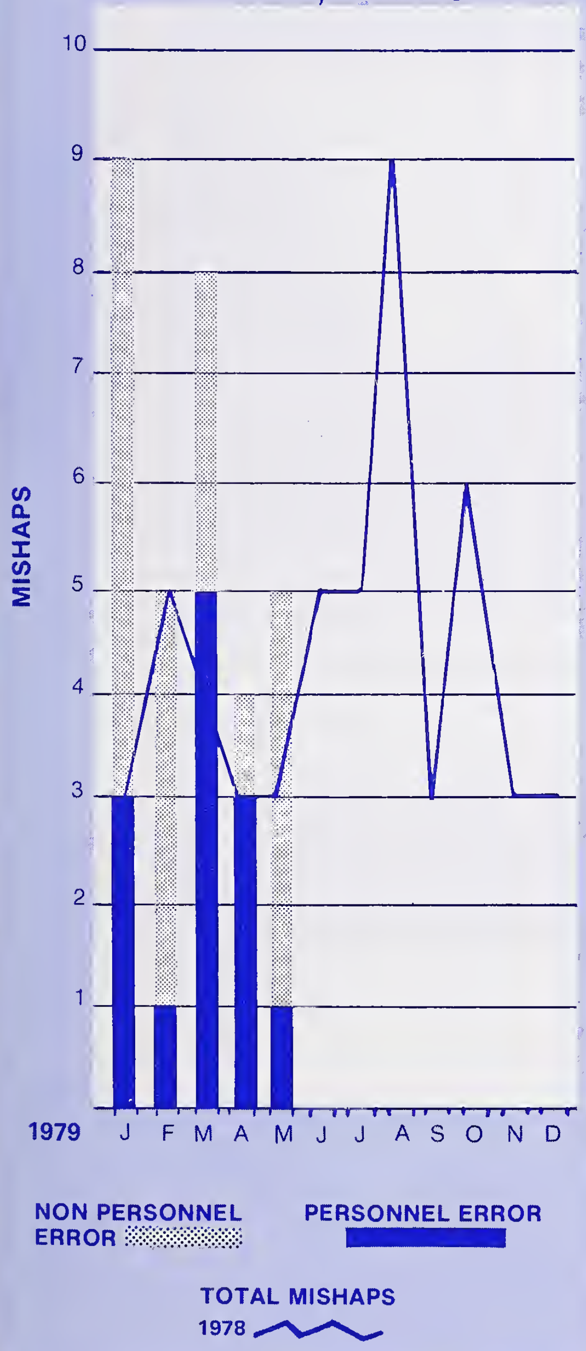
As the aircraft passed above the runway threshold, its airspeed was 184 knots — 61 knots above its "reference" speed for that point in the approach. Its landing speed was 163 knots, 40-45 knots too high. Even though the aircraft first touched down at about 2,540 feet down the 5,500-foot runway, "a successful go-around could have been accomplished as late as 4,200 feet down the runway."

The dangerously high rates of descent of over 2,000 feet per minute within two miles of the threshold should have indicated to the crew that the approach was improper and that a missed approach was necessary. The Board said the pilot's lack of awareness resulted from "a breakdown in crew coordination and inadequate monitoring of cockpit instruments by both pilots. Such excessive deviations from a normal approach would have caused an alert and prudent pilot to execute a missed approach. Yet, when questioned, the pilot stated that he never considered such an action."

The Board also expressed concern that the copilot did not alert the pilot to the high speeds and sink rates, and did not "take corrective action when a dangerous situation was developing." The Board reiterated a statement, made in a 1972 report of a fatal approach accident, that "the second-in-command should not passively condone an operation of the aircraft which in his opinion is dangerous, or which might compromise safety."

Missile Mishap Report

DOD CLASS A, B and C



BENT PINS

During electrical mating of the Missile Guidance Set (MGS) to the MINUTEMAN II missile third stage, a technician inadvertently bent pins 4, 5 and 52 in the third stage raceway connector. The damaged pins required removal of the missile to facilitate depot repair.

The electrical mate of the raceway connector is performed blind; therefore extra care and caution is required when making this connection. Due to the critical nature of this task and the past history of similar mishaps, all supervisors, instructors, and evaluators should continue to emphasize the caution required during this portion of the MGS recycle.

WET MISSILE

An electromechanical team (EMT) replaced the Guidance and Control (G&C) chiller because of a locked rotor condition. The team then unsuccessfully attempted an Aerospace Vechiliar Equipment (AVE) startup prior to performing the "power not applied" checkout. Determining the problem to be frozen chromate in the lines, they waited two hours for it to thaw. A second AVE startup was attempted. Again the AVE did not start. The next day another EMT dispatched to the site discovered the chromate level 5 gallons lower than on the previous day. Checking for leaks, chromate was found dripping from the bottom of the missile. The source of the leak was in the cold plate of the digital computer unit. This was caused by the cold plate adhesive's failure due to excessive pressure in the G&C cooling system. The excessive pressure developed when the first AVE startup was attempted with frozen chromate blockage in the G&C chiller. Contamination from the leaking chromate caused extensive damage to the missile first, second and third stage cables. The G&C unit and missile were removed and returned to depot for repair.

To prevent future mishaps of this type, an AFTO Form 22 is being submitted to change TO 21M-LGM30G-2-6. This change will prohibit AVE startup when there is a defective cooling system.

ACE TOPICS

ANOTHER T-38 MYTH SHOT DOWN I came across one situation where the pilots did everything right but were taken in by a "T-38 myth" — "If you fly 2000 feet below or 10,000 feet above freezing level, your chances of encountering ice are slim."

So these two troops are flying from point A to point B at 6000 feet with freezing level at 8000 to 12,000 feet. The OAT at their cruising altitude was approximately 47° F and moderate rain showers were encountered enroute. Upon landing, again during a moderate rain shower, both engines flamed out!

Postflight maintenance investigation revealed damage to both engines' first stage compressors, most probably from ice ingestion. Wondering about their 2000-foot "buffer," I went to the weather shop and learned a few things about flying near freezing levels.

First, if it's raining, the moisture will drive the freezing level down. How far down is a function of the intensity and density of the rain shower.

Second, because of possible engine icing, the test cell folks won't run an aircraft engine on the test cell if the temperature dewpoint spread is less than seven degrees and the OAT if 40° F to -14° F. Well, these conditions certainly existed in this case and there sure was evidence of ice ingestion! I think it would be a safe bet that the aircraft was in and out of the freezing level the entire route, through no fault of the crew!

I guess the bottom line is, if it looks like it's "going to be close" with the freezing level, wait for improved conditions or it'll be back to the BOQ for a discussion of how you won't pick up icing if you fly 2000 feet below the freezing level! — The Myth! — Capt Holliker

FOOLPROOF We used to preach that the T-38 gear system was "foolproof" but events have proved us wrong. In fact, the T-38s closed 1978 with a resounding screech as three T-38s slid to a stop — sans gear. These mishaps generated a great deal of heat but so far they haven't produced much light.

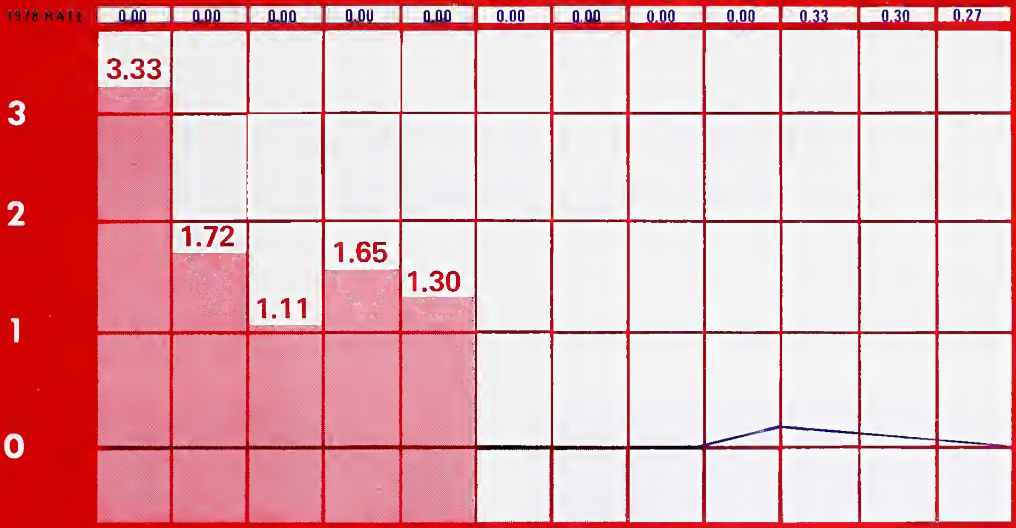
In over six million flight hours, ATC T-38s have had only three mishaps as a result of actual unsafe gear. On two occasions, the gear would not extend and the crew followed the guidance of the day and ejected. In the third case, one main gear collapsed on landing due to a failure of the side brace linkage. The crew was uninjured and the aircraft was repaired. Also, there have been several landings with the nose gear up, but these never resulted in significant damage. On the other hand, a records check indicates that ATC averages three landings per month where the gear warning system indicates unsafe. The most common cause of the unsafe indication was a maladjusted gear down lock switch (the gear was safe but the warning switch electrical connection was bad). Until very recently, crews have always elected to land after a visual confirmation of the gear position or after performing an alternate release.

When we talk about an unsafe gear versus unsafe indications, we get into a little philosophy. The Good Book (Dash One) says, "If all gear are fully down, but one or more are indicating unsafe, stop straight ahead on the runway and have the gear safety pins installed." This statement merely recommends an action proven to be the most prudent by six million flight hours and numerous malfunctions. A visual confirmation of gear position should supersede the electrical warning system in the aircraft, but an analysis of risks versus benefits dictates that the aircraft not be taxied with even the slightest possibility that the gear is unsafe. The Good Book also says "Before attempting a landing with the gear up or unsafe, carefully consider whether to attempt a landing or eject." Guidance is then given on which conditions make landing an option. If an unsafe, partially extended, or up and locked main gear is confirmed, the choices boil down to ejection or retracting the gear and bellying in. A gear up landing is a maneuver with guaranteed aircraft damage and possible personal injury so the decision is left to the pilot's judgment. Recent experience indicates gear up landings are a viable option, but the pilot still has the responsibility to make a decision based on systems knowledge, evaluation of personal skills, and appreciation of the odds — one main gear collapse in 6,198,383 flight hours. If T-38 pilots do not take the time to learn the aircraft systems or count on luck without knowing the odds, we will never again have a "foolproof" system.

Capt Schofield.

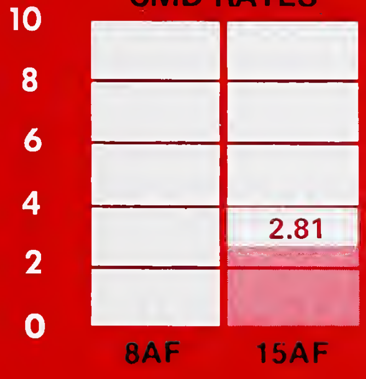
1979 Flying Safety Rate

SAC CLASS A MISHAP RATE (PER 100,000 FLYING HRS)



MISHAPS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	0	0	0	0	0	0	0	0	0	1	0	0
1979	1	0	0	1	0	0						

1979 SUBORDINATE CMD RATES



LEGEND —— 1978 RATE

MISHAP STATUS

B-52H KC - 135Q	JAN 79 APR 79

BIG INSTRUMENT

FILING TO A LOW ALTITUDE INITIAL APPROACH FIX

Captain Tome H. Walters, Jr.
Instrument Division
1st Combat Evaluation Group
Barksdale Air Force Base, Louisiana

Q. Can I file to a low altitude initial approach fix (IAF)? Are there any command restrictions?

A. Yes, you certainly can file to a low altitude IAF so long as there are published minima for your aircraft category. There are no command restrictions prohibiting you from doing so.

SAC aircraft, in recent years, have been primarily concerned with the high altitude environment when it came to filing to an initial approach fix. The B-52 and KC-135 were both strictly Category E aircraft for many years and there were almost no Category E minima published for low altitude instrument approach procedures. Then in 1974, C-135 aircraft were allowed to apply Category D minima when approach speed (or maneuvering speed for a circling approach) was less than 166 knots. That opened the door to low altitude procedures for 135 pilots.

Although 135 pilots routinely fly low instrument approach procedures, many (or most) have an abiding suspicion that they'll get sent to the penalty box if they try to file anything but a high IAF. Not so! FLIP requires AF pilots to file to an IAF. But one IAF is as good as another — high or low. Our point is not to declare war against high procedures. Our point is to explain what your options are and let you know you have a choice.

ADVANTAGES

The June Big Instrument article discussed descent profiles and fuel conservation. It pointed out that a high airspeed, clean configuration, enroute descent is the most fuel efficient descent profile. High altitude IAF's often are not conveniently located. But where a high IAF is frequently out of the way, a low IAF might be exactly where you would like it to be. Compare the HI-TACAN RWY 17 (Figure 1) at Altus AFB OK with the TACAN RWY 17 (Figure 2). If you were enroute from the north or east, an enroute descent to Blair would obviously save time and fuel.

Filing to a low IAF can also make it easier for the pilot to remain position oriented. Pilots frequently file high IAF, but plan on flying a radar vectored enroute descent to an instrument approach. Awareness of position orientation frequently decreases during a vector. Filing and flying to a fix of your choice might help to focus your attention on staying position oriented throughout the descent.

Another advantage of filing and flying to a low IAF when you intend to fly an enroute descent is that it saves changing your route of flight and avoids possible clearance problems. If you were planning on an enroute descent to Altus for an approach to RWY 17, Blair is the place to go. When Center asks, "what type of approach are you requesting at Altus?", and you answer — "Center, we're requesting descent to Blair for a TACAN straight in approach, RWY 17," you've minimized the margin for error. There's no doubt where you're going.

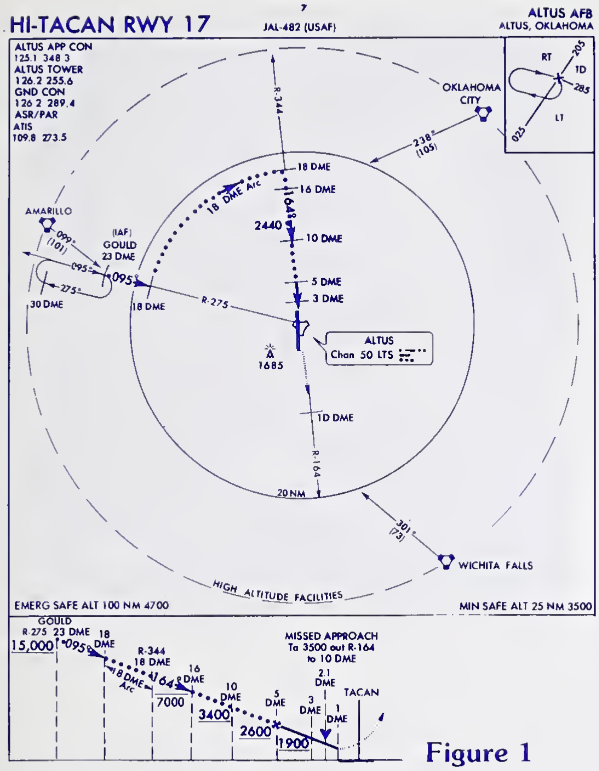


Figure 1

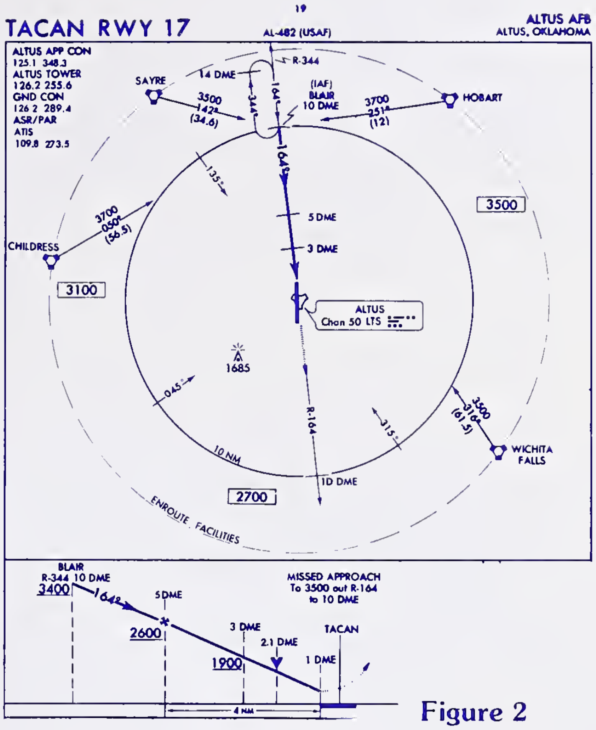


Figure 2

CONSIDERATIONS

Service Volume Area — If you file to a low IAF, remember to consider the service volume area of the navaids you're using, especially if the low IAF is defined off an L or T category navaid. (L-40 NM up to 18,000′ MSL; T-25 NM up to 12,000′ MSL) For *flight planning* purposes, make sure you remain within the service volume of one navaid until you enter the area for the next. Notice that flight planning was emphasized. *Inflight,* you can exceed the guaranteed interference-free distance once you can tune and identify the navaid and are receiving a signal suitable for navigation. The new solid state TACAN usually works well outside the given distances.

Lost Communication Procedures — What would you do if you lost communications enroute to a low IAF while level at FL 330?

Answer: Exactly the same thing you would do if you lost communications enroute to a high IAF. The procedures are the same. The essential difference in the two situations is the amount of altitude to lose.

The first step is to let ATC know by squawking 7700 for one minute, then 7600 for the next 15 minutes.

If you were in VFR conditions, you could visually clear yourself and descend from the PCA. ATC controllers would be clearing a path in front of you.

If you were IMC, you would proceed to the low IAF at FL 330 and establish a holding pattern. You would hold until your computed estimated arrival time, then descend to the published initial approach altitude in holding, then fly the approach.

One question that comes up here is — "Will I be able to receive a good signal at that altitude if the navaid is an L or T category?" The answer is — "You will probably be able to receive the signal." If not, you could legitimately consider the situation an emergency. At that point, you would do whatever was necessary to safely recover the aircraft. For example, you could proceed to any other IAF defined off a navaid you were able to receive and fly an approach of your choice. ATC would protect the airspace for you. Or, you might go to the filed fix, have the navigator set you up in a holding pattern on radar, descend in the pattern, and fly an approach off any navaid you were able to receive. Like any emergency situation, the pilot would use good judgment to reach the best solution for the particular problem.

Techniques — Filing to a low IAF and flying the approach does not require any new or different techniques. You might read paragraph 6-3 in AFM 51-37 — Enroute to a low altitude IAF. The only point to emphasize is — "reduce to maneuvering speed before reaching the IAF." If you're doing 250 KIAS clean at an IAF that's four miles from the FAF, you might be in for a sporty course.

PROFESSIONAL PERFORMERS

Individuals selected for these pages as SAC's top professional performers of the month are chosen from nominations made by all SAC units. Selection is made only after all nominations have been carefully screened and those chosen meet the highest standards of excellence outlined in SACR 127-2.

Captain Robert A. Munger, U-2 Aircraft Commander, Beale AFB.

HEADS UP

Captain Robert A. Munger, 9th SRW, was flying a high altitude U-2 training sortie. Five and one-half hours out the engine began to run rough, accompanied by fluctuating RPM. Troubleshooting did not reveal any discrepancies with the engine instruments or engine operation, but within minutes of the first indication of problems the engine abruptly flamed-out. Captain Munger configured the U-2 for a flameout descent. Declaring an emergency with Center, he spiraled down over the base for a flameout landing. Numerous airstarts were unsuccessful, so he descended to a lower altitude and coordinated his landing with Reese AFB. With winds within four knots of the limiting crosswind for a U-2, he made a flawless flameout pattern and landing. The timely and decisive actions of Captain Munger prevented possible injury to himself and resulted in the safe recovery of an extremely sensitive and valuable reconnaissance aircraft.

MINUTEMAN Crew R-174, 341st SMW, Malmstrom AFB: Capt Gale G. Lee, MCCC and 2Lt James W. Terry, DMCCC.

MINUTEMAN CREW

On two separate occasions, Crew R-174, from the 341st SMW, expertly resolved serious problems which precluded degradation of the Minuteman II command data buffer weapon system, damage to equipment and personnel injury. On one recent alert, Capt Lee smelled smoke and the distinctive odor of an electrical overheat in his launch control center (LCC). He immediately notified other squadron crews of a possible fire/overheat condition. The LCC fire overheat checklist was accomplished and the crew finally determined the problem to be in the alarm-monitor set. Communications job control dispatched a maintenance team which discovered a badly burned circuit board in the cable pressure alarm panel drawer of the alarm-monitor set. On a subsequent alert, Capt Lee and Lt Terry were monitoring the return of a reentry system to the strategic missile support base from one of their launch facilities (LF). Approximately 45 minutes after the convoy departed the LF, the crew heard a partial transmission from the helicopter accompanying the convoy. This transmission referred to a stuck vehicle. Capt Lee contacted his flight security controller (FSC) to determine the location and condition of the convoy. The FSC was unaware of any problems with the convoy so Capt Lee checked with wing security control. He was told the payload transporter was in fact immobilized in his flight area. Capt Lee and Lt Terry referred to SAC security directives and declared a security situation 1C.

Capt Lee and Lt Terry's attention to activities within their flight area of responsibility, and timely decisions resulted in the continued security and safety of a critical component and earned them recognition as Minuteman Crew of the Month.

MAINTENANCE NCO

TSgt Bernard M. Hautala, 44th SMW, Ellsworth AFB, is SAC Maintenance Airman of the Month. He earned this award for outstanding technical competence, initiative, and superior managerial skills which resulted in nearly $200,000 savings in materiel costs and a savings of nearly 8,000 man-hours. Sgt Hautala is a dedicated noncommissioned officer and a valuable asset to the United States Air Force.

SAFETY NCO

SSgt Fred L. Gondzar, Jr. is SAC Safety NCO of the Month. As Safety NCO for the 90th Organizational Missile Maintenance Squadron, Sgt Gondzar combines his broad safety and systems knowledge with his astounding initiative and intent interest in his duties. He applies uncompromising diligence to safety. Through aggressive application of safety principles and judicious use of command support, he effectively manages a program that eliminates the root causes of mishap potentials.

FLYING CREW

Crew E-11, 319th BMW, Grand Forks AFB, was on takeoff roll for a training mission in a B-52H. After passing S1 speed, the number six tire had a complete tread separation, and after takeoff the crew was advised that a large amount of rubber and pieces of metal had been found on the runway. An inspection revealed a hole in the aircraft fuselage, some gear assembly damage, and a complete tread separation of the inside left rear tire. This made necessary an emergency landing with the damaged gear retracted. The crew computed landing data and completed all checklist items in preparation for the emergency landing. A difficult landing requiring the simultaneous touchdown of all remaining gear was needed. The landing was accomplished safely with no further damage. The superior airmanship and the professional competence shown by the crew prevented a mishap which could have resulted in major damage to a B-52H and injury to eight crewmembers. The crew included: Capt Jerry T. Skinner, pilot; 1Lt Frederick K. Lange, copilot; Capt David V. Krueger, RN; 1Lt Gordon R. Sidwell, N; Capt Robert F. Henke, EWO; A1C Ralph G. Woodward, FCO; Capt William G. Conklin, IEWO; and Capt Tommy G. Taylor, IRN.

TITAN CREW

Titan Crew E-091, from the 390th SMW, continuously displayed superb skill and competence on several alert tours. While managing a hazardous missile propellant recycle task, each step of the operation was thoroughly researched and evaluated, completely coordinated with maintenance personnel to insure safety, and conducted in a professional and error-free manner. In addition, the 3901st SMES evaluated this propellant recycle operation and favorably commented upon this crew's performance.

Crew E-091 consistently maintains high standards of performance in daily alert activities. All four crewmembers received "highly qualified" ratings on a recent standardization evaluation. Lt Gaston and Lt Crowley earned positions on the wing Emergency War Order Honor Roll by scoring 100% on the last seven monthly proficiency examinations. Crew E-091 consistently accepts and accomplishes all responsibilities in a professional manner with dignity, pride and enthusiasm. These accomplishments and qualities merit their selection as SAC's Titan Crew of the Month.

TITAN Crew E-091, 390th SMW, Davis-Monthan AFB: MCCC 1Lt Christopher J. Gaston, DMCCC 1Lt Thomas C. Crowley, MSAT A1C Charles E. Borge, and BMFT A1C Terry D. Sneed.

DEBRIEF

Combat Crew is proud to celebrate its 29th year as your safety magazine. As we begin our 30th year of publication, we hope that you, the reader, will continue contributing in the same excellent manner. Editor

The Legacy of the Triangle . . .

The author's byline was inadvertently omitted from this article which appeared in the June issue. Combat Crew wishes to say thanks to Capt Frank Walker, 19th BMW, Robins AFB.

Lieutenants Makuta and Betts, the first all-Second Lieutenant missile crew in Air Force history, sharpen their skills in the 90th SMW missile procedures trainer at F.E. Warren AFB.

SMSgt Riddick, 1st CEVG, completes 10,000 hours in aerial refueling — the fourth boom operator to do so.

Combat Crew

Magazine of the Strategic Air Command · 30th Year of Publication

GEN. RICHARD H. ELLIS
COMMANDER IN CHIEF, SAC

BRIG. GEN. RICHARD A. BURPEE
Inspector General

COL. BURR V. MILLER, JR.
Director of Safety

STAFF

MAJ. STEPHEN J. MILLER
Editor

G. FRANCIS FARRELL
Associate Editor

SSgt. RICHARD L. WALDROOP
Art Editor

MARY JANE ABBOUD
Editorial Assistant

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ON OUR COVER

Combat Crew salutes the people of SAC, guardians of freedom, as the magazine begins its 30th year.

SACRP 127-1 **VOL. XXIX NO. 7** **JULY 1979**

COMBAT CREW is an internal publication of the Strategic Air Command with the sole purpose of promoting safety. The contents of this magazine are informative and not to be considered as directive in nature. Facts, testimony and conclusions of all mishaps printed herein may not be construed as incrimination under Article 31 of the Uniform Code of Military Justice. All names, dates and places used in conjunction with mishap stories are fictitous. Written permission must be obtained from Headquarters, Strategic Air Command, before any material may be reprinted by other than U.S. Air Force organizations. Use of funds for printing this publication has been approved by Hq. USAF. Distribution FX, controlled by IGFC. SAC units submit distribution requests through local PDO.

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SAC SAFETY SCREEN

97 BMW, Blytheville Crew E-22: P Capt James E. Boyd, CP Capt Gary C. Whitley, RN Capt Thomas H. Olson, NN 1Lt Bradley W. Mandeville, EW 1Lt Frederick R. Moore, AG SrA Dale A. Emmons

97 BMW, Blytheville Crew E-13: P Capt Thomas W. Ellers, CP 1Lt Earle L. Lund, III, RN Capt Charlie R. Owens, NN 1Lt Ricky J. Ferguson, EW Capt Thomas W. McDonald Jr, AG A1C Donald A. Bumbar

97 BMW, Blytheville Crew E-106: P Capt Philip Gartner, CP 1Lt Gert-Jan P. Visser, NN Capt Thomas N. McKnight, Jr, BO SrA Edward L. Mikell

379 BMW, Wurtsmith Crew R-13: P Capt Larry B. Voss, CP 1Lt Brandon A. Buttrick, NB Capt James D. Webb, NN Capt Craig S. Westerlund, NE 1Lt John S. Barnett, Jr, AG A1C Roland T. McCall

19 BMW, Robins Crew R-113: P Capt William P. Padgett, CP 1Lt John A. Kearns, NN Capt Kenneth P. Daigle, BO Sgt Jeffrey McGirt

19 BMW, Robins Crew S-02: IP Capt Robert A. Lavigne, CP 1Lt Donald W. Hiebert, IB Capt Joe M. Perry, IN Capt David C. Gooden, IE Capt Carl A. Foerster, IS SSgt David M. Gray

68 BMW, Seymour Johnson Crew E-15: P Capt Jerry M. Hopson, CP Capt John F. Kirk, RN Capt John D. Rose, NN Capt George L. Lane, EW 1Lt William L. Spivey, AG SrA James M. Flynn

68 BMW, Seymour Johnson Crew E-104: P Capt Richard D. Wheeler, CP 1Lt Kosta G. Asselanis, NN 1Lt Michael W. Skojec, BP Sgt Derek T. Suficiencia

909 AREFS, Kadena Crew R-131: P Capt Kenneth J. Wiatrek, CP 2Lt Cyril K. Haines, Jr. NN 1Lt Ernest E. Infinger, Jr, IS SSgt Michael H. Strickland

44 SMW, Ellsworth Crew S-010: MCCC Capt Gregory K. Lundin, DMCCC 2Lt James M. Jenkins

90 SMW, F. E. Warren Crew R-187: MCCC 1Lt David A. Newbry, DMCCC 2Lt Michael P. Greene

91 SMW, Minot Crew E-125: MCCC Capt Terry Crossey, DMCCC 1Lt Steve Proctor

308 SMW, Little Rock Crew R-118: MCCC Capt Andrew M. Schmitz, DMCCC Capt Carol E. Ludwig, MSAT SrA Donald W. Fent, MFT Sgt Wade A. Davis

351 SMW, Whiteman Crew S-173: MCCC Capt Martin J. Klena, DMCCC 1Lt John F. Ganaway

The SAC Safety Screen is an honor roll of SAC's most professional crews. To gain listing on the Screen, crew members must be nominated by their unit commanders and meet high selection criteria of experience in their aircraft or missile system *IAW SACR 127-2.*

★U.S. Government Printing Office 1979-665-046/5

UNIVERSITY OF FLORIDA
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HALL OF FAME

TACTICAL FLYING

OVER TWENTY-THREE YEARS	
170 AREFG, McGuire (NJANG)	Feb '56
OVER TWENTY-ONE YEARS	
171 AREFW, Greater Pittsburgh (PAANG)	Mar '58
157 AREFG, Pease (NHANG)	Jun '58
OVER TWENTY YEARS	
97 BMW, Blytheville	Aug '58
940 AREFG, Mather (USAFR)	May '59
OVER NINETEEN YEARS	
307 AREFG, Travis	Sep '59
OVER EIGHTEEN YEARS	
151 AREFG, Salt Lake City (UTANG)	Feb '61
161 AREFG, Sky Harbor (AZANG)	Apr '61
126 AREFW, Chicago O'Hare (ILANG)	Apr '61
OVER SEVENTEEN YEARS	
134 AREFG, McGhee Tyson (TNANG)	Aug '61
340 AREFG, Altus	Feb '62
OVER SIXTEEN YEARS	
301 AREFW, Rickenbacker	Jul '62
96 BMW, Dyess	Aug '62
OVER FIFTEEN YEARS	
19 BMW, Robins	Aug '63
OVER FOURTEEN YEARS	
160 AREFG, Rickenbacker (OHANG)	Dec '64
OVER THIRTEEN YEARS	
320 BMW, Mather	Jul '65
OVER TWELVE YEARS	
452 AREFW, March (USAFR)	Sep '66
92 BMW, Fairchild	Feb '67
OVER ELEVEN YEARS	
55 SRW, Offutt	Jul '67
2 BMW, Barksdale	Aug '67
OVER TEN YEARS	
5 BMW, Minot	Feb '69
OVER NINE YEARS	
42 BMW, Loring	Sep '69
141 AREFW, Fairchild (WAANG)	Oct '69
28 BMW, Ellsworth	May '70
OVER SEVEN YEARS	
7 BMW, Carswell	Mar '72
101 AREFW, Bangor (MEANG)	Mar '72
416 BMW, Griffis	May '72
OVER SIX YEARS	
305 AREFW, Grissom	Aug '72
376 SW, Kadena	Nov '72
379 BMW, Wurtsmith	Apr '73
OVER FIVE YEARS	
384 AREFW, McConnell	Mar '74
189 AREFG, Little Rock (ARANG)	May '74
OVER FOUR YEARS	
43 SW Andersen	Dec '74

ICBM

OVER FOURTEEN YEARS	
90 SMW, F E Warren	Jul '64
1 STRAD, Vandenberg	Sep '64
OVER THIRTEEN YEARS	
308 SMW, Little Rock	Aug '65
OVER NINE YEARS	
341 SMW, Malmstrom	Apr '70
OVER FIVE YEARS	
390 SMW, Davis-Monthan	Jul '73
OVER FOUR YEARS	
351 SMW, Whiteman	Oct '74
91 SMW, Minot	Nov '74

To gain listing in the Hall of Fame, a SAC or ARF unit must be Class A mishap free for 48 months